Bi-directional Blowers for Cooling Laptop Computers

DESCRIPTION

Background of the Invention

[Para 1] This invention relates generally to the field of thermal management for computer and electronics systems and more specifically to bi-directional blowers for cooling laptop computers.

[Para 2] Fans and blowers are the essential components in the active air cooling for computer and electronics systems, as the power is increasing dramatically. To extend air cooling limit and make more efficient air cooling, duct cooling must be utilized. Because the heat density in a system is different in various zones, the ideal approach is to remove heat from hot region to outside of system box immediately through duct. However, it is a real challenge to make it happen because of the compact design with many different components such as CPU, PCI components, graphics and network processors, memory and other components.

[Para 3] Axial fans are normally used in desktop, server systems because axial fans are the most efficient way to move air in same direction, but blowers are commonly used for laptop cooling because of the space limitation. Axial fan is more efficient because its blades cut air mass from intake side and move it to other side immediately. A same size centrifugal blower is not as efficient as an axial fan because of these reasons: 1) the intake size is much smaller; 2) the air mass moves out of the blades driven by centrifugal force due to the high rotational speed of the blades or impellers; 3) most of the air mass will have to go through the circular tunnel before it escapes through outlet; 4) and further, the air is dragged by the tunnel walls during circular movement. However, blowers are still widely used because it has unique advantages of

changing air flow direction, fitting in constraint space, and cooling small hot device such as a heat sink.

[Para 4] Overheating is a common problem for high power laptop, although blowers have had to be used for laptop cooling due to space limitation. The inlet of the centrifugal blower in the laptop cooling model is usually located at the bottom near CPU. This requires a 2~4mm air gap between the laptop bottom and the desk top surface, so that the "warm" air can flow into the blower. Therefore, the air gap forms a huge thermal resistance in the heat transfer path of lower side. Assuming the desk is made of wood, its thermal conductivity is about 7~12 times of natural air. Clearly, the thinner the air gap, the more efficient the heat dissipation through bottom side because the desk underneath can be utilized as a huge natural heat sink.

Brief Summary of the Invention

[Para 5] The primary object of the invention is that the bi-directional blowers that blow hot air out from the system box and suck room air into the system box simultaneously.

[Para 6] Another object of the invention is that the bi-directional blowers can be used for space constrained conditions, such as laptop computers, thin blade servers, or PCI cards, e.g., graphics device, for efficient duct cooling because it plays a role of two blowers.

[Para 7] The special object of the invention is that a pressure-type bi-directional blower can enhance heat dissipation for a laptop because the cool (room temperature) air is sucked into the box as well as the hot air is blown out because intakes or outlets are designed on the sides. Thus the air gap between laptop bottom and desk top can be eliminated so that the table can be served as a natural heat sink.

[Para 8] A further object of the invention is that a hybrid bidirectional blower maintains the advantages of sucking in cool air as well as blowing out hot air, but it has higher flow capability because the blow-in function utilizes

centrifugal mechanism to move air through the intakes located on top or bottom of the laptop.

[Para 9] A very valuable object of the invention is that various rotary blades are explored, for example, a combination of blades and impeller which makes the bi-directional functions more efficiently.

[Para 10] Other objects and advantages of the present invention will become apparent from the following descriptions, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

[Para 11] In accordance with a preferred embodiment of the invention, the Bi-directional Blowers for cooling laptop computers comprising a motor, a rotary part of blades and/or impellers, an optional cover and a housing frame with built-in broken walls, stationary blades and airfoils. The number of blades should be more than usual, say more than 18, enough to enable bi-directional functions effectively. The broken walls with the width same as or wider than the pitch of rotary blade pitch. While the blades/impellers rotate, the broken walls with the junction to the blades/impellers will always form a separate zone, so that suck-in and blow-out functions can work simultaneously. The stationary blades in the intake or outlet tunnels are designed to control the flow volume as well as flow directions. More detailed descriptions will be given as follows.

Brief Description of the Drawings

[Para 12] The drawings constitute a part of this specification and include exemplary embodiments to the invention, which may be embodied in various forms. It is to be understood that in some instances various aspects of the invention may be shown exaggerated or enlarged to facilitate an understanding of the invention.

[Para 13] Figure 1 is a perspective view of a pressure type bi-directional blower, which intakes and outlets are all located on the sides.

[Para 14] Figure 2 is a perspective view of a hybrid type bi-directional blower, which shows that the function of blowing-out hot air is pressure type and the function of sucking-in cold air is centrifugal type with the intakes located on top or bottom sides.

[Para 15] Figure 3 is a perspective view of a pressure type bi-directional blower, which uses a combination of blades and impeller as a rotary part.

[Para 16] Figure 4 is a perspective view of a hybrid type bi-directional blower, which uses a combination of blades and impeller as a rotary part.

[Para 17] Figure 5 is a perspective view of a pressure type one way blower, which shows both inlet and outlet can be located on sides with various angles.

Detailed Description of the Preferred Embodiments

[Para 18] Detailed descriptions of the preferred embodiment are provided herein. However, it is to be understood, that the present invention may be embodied in other forms. Therefore, specific details disclosed herein are not to be interpreted as limiting, but rather as a basis for the claims and as a representative basis for a skilled one to understand the principle of the invention.

[Para 19] To accomplish the important function of the invention, there is shown in Figure 1 the pressure type bi-directional blower used for a laptop computer. It is assembled with a motor 120 fitted in the drum of the rotary blade 130, the stator of the motor 120 is mounted on the housing frame 110, and the optional cover 140. The structure of the housing is the vital part of the invention. The broken walls 112 and 113 form a separate zone with the conjunction of the blades 130 to separate the suck-in and blow-out regions, such that the intake 102 draws hot air into the blower and blows out through outlet 101, and the intake 103 draws in cold air and blows to front of heat sink through outlet 104 to enable duct cooling, as the motor rotates count clockwise. The separate zone is actually a gate that blocks air flow from one side to the other. The stationary blades and airfoils 114 and 115 are designed to control flow volume and flow directions. The blade should be acute angles

with the air flow velocity vector in order to minimize the noise due to air dynamics. When rotary blades spin, the stationary blades distribute flow volumes as even as possible through the position and intake angles. When air flows into the tunnels among the airfoils, the velocity of the air mass is adjusted as much as possible to perpendicular to the outlet area. The motor pin 121 spins in the stator of the motor, which is assembled to the housing frame 110. The cover 140 is optional depending on how to use the blower. The screw holes 111 are used to fix the blower to the system.

[Para 20] The principle of this invention is that partial vacuum forms between the blades when they pass the broken walls (the separate zone) which blocks air flowing from one side to the other. The so called "negative pressure" sucks air from outside of the blower into the space between the blades until most of it is driven out through outlet by the centrifugal force. This periodic rotating forms suck-in and blow-out channels.

[Para 21] Turning to Figure 2, there is shown the hybrid type bi-directional blower. All features depicted in this drawing are similar to Figure 1. It is called hybrid because the inlet 205, as current technology, is located on top or bottom of the blower. Thus, the suck-in function works as conventional centrifugal blower. It transports air very efficiently because it eliminates air travel in the circular tunnel as conventional blower. Although suck-in flow is not as much as a conventional blower of the same size, the total efficiency is better because the other half blows out hot air from the system box with the pressure type mechanism.

[Para 22] Comparing Figure 3 with Figure 1, one can notice that the difference is the rotary part which is a combination of blades and impellers sitting on the circular plate extended from the drum. The separate zone is formed with the broken walls 312, 315, 314 and 313 conjunct with the blades and impellers, such that the suck-in and blow-out channels are constructed. The blow-out channel draws hot air from the inlet 302 and expels out through outlet 301 and the suck-in channel draws cold air from intake 303 without airfoils and blows to heat sink through outlet 304 for duct cooling, as the rotary part spins count clockwise. The important embodiment of the invention depicted in this

figure is the combination of blades and impellers. The inner blades extended from drum drives air from inlet forward so to provide additional air supply to Impellers which move air faster than blades.

[Para 23] Comparing Figure 2, Figure 4 shows a hybrid bi-directional blower in which the rotary part of blades and impellers in Figure 3 is used to replace the radial blades in Figure 2.

[Para 24] Figure 5 illustrates a pressure type one-way blower. The rotary part 420 of combination of blades 422 and impellers 421 is shown in the figure but radial blades can also be applied. Air flows in through inlet 401 and move around in the circular tunnel 413 formed with the cover 410, and finally escapes through the outlet 402. There are two significant features: 1) Intake 401 is located on side of the blower, rather than on top or bottom as conventional centrifugal blower. Using this type blower, the air gap between a laptop bottom and desk top side can be eliminated for better heat conduction, as well as maintain high flow capability; 2) The blocking walls 411, the stationary blades and airfoils 404 shown in the illustration are also very important features in order to have more evenly air flow across the outlet.

[Para 25] While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.